PIM and VSWR System Calculators

The passive intermodulation (PIM) and voltage standing wave ratio (VSWR) System Calculators support two common needs:

1) various components can be selected to be included in the RF path for analysis at a given frequency

2) vector addition calculations are performed for both a typical and a worst-case result

PIM System Calculator

The PIM System Calculator accepts the selected components' PIM specifications and losses along with model numbers and lengths for various coaxial cables being used. Another option allows you to select one of three common test equipment power options: 2, 20 or 40 watts. This option provides you with the third-order variation as the test signals are changed from the default level of 20 watts. Theoretically, this number should be 3 dB per dB, but numerous tests by several parties have indicated a 2.3–2.6 dB per dB range for real-world measurements.

If a Tower Mounted Amplifier (TMA) is included in the RF path, it is recommended that it be active during PIM testing. For these cases, TMA gain should be input into the calculator, resulting in higher levels of PIM at the bottom end from contributors beyond the TMA.

Since each component in the RF path has its individual PIM specification—usually using two 20-watt carriers—values and calculations must be adjusted as the RF loss away from the test set increases, or if the powers of the test tones are a wattage other than 20. Once the reflected PIM value for each component is calculated, it must be combined with other reflected PIM values to simulate the composite result seen by the bottom-end test equipment.

Knowing that each reflected PIM value is a vector that has both amplitude and phase further complicates the combining. This means that a number of components having specific PIM specifications could yield very different "system" PIM results depending on the cable lengths (phase differences) between them. Since it is virtually impossible to calculate every combination with unknown cable lengths, the PIM System Calculator generates two results: a typical value where the vectors combine randomly and a worst-case value where the vectors all combine in-phase.

It should be noted that RF path loss can reduce the power at some components to the point where the reduced PIM product at that component falls below the noise floor of the PIM test equipment. In that case, the result is highlighted in yellow.

VSWR System Calculator

The VSWR System Calculator accepts the selected components' VSWR specifications and losses along with model numbers and lengths for the coaxial cables being used. Similar to the PIM System Calculator, it uses this information to calculate both a typical and a worst-case value which depends on the vector addition of the individual contributors.

When a Tower Mounted Amplifier (TMA) is included, the system VSWR calculation reflects the results in the transmit frequency (downlink) band only.

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